

Table 11.1 – Emissions from Electricity Generators, 2003

(Thousand short tons of gas)

	<u>1990</u>	<u>2000</u>	<u>2001</u>	<u>2002</u>	<u>2003</u>	<u>2010</u>	<u>2020</u>	<u>2025</u>
Coal Fired								
Carbon Dioxide	1,672,757	2,083,038	2,016,017	2,059,779	2,099,132	2,358,682	2,614,183	2,950,672
Sulfur Dioxide	15,220	10,623	10,004	9,732	N/A	N/A	N/A	N/A
Nitrogen Oxide	5,642	4,563	4,208	4,094	N/A	N/A	N/A	N/A
Methane	11	13	13	13	N/A	N/A	N/A	N/A
Nitrous Oxide	25	31	31	31	32	N/A	N/A	N/A
Petroleum Fired								
Carbon Dioxide	108,467	98,106	108,798	78,374	106,373	106,147	117,840	120,415
Sulfur Dioxide	639	482	529	343	N/A	N/A	N/A	N/A
Nitrogen Oxide	221	166	170	130	N/A	N/A	N/A	N/A
Methane	1	1	1	0	0	N/A	N/A	N/A
Nitrous Oxide	1	1	1	1	1	N/A	N/A	N/A
Gas Fired								
Carbon Dioxide	188,275	298,065	305,230	315,812	303,466	399,152	559,935	558,343
Sulfur Dioxide	1	232	262	8	N/A	N/A	N/A	N/A
Nitrogen Oxide	565	422	359	270	N/A	N/A	N/A	N/A
Methane	0	1	1	1	0	N/A	N/A	N/A
Nitrous Oxide	0	1	1	1	0	N/A	N/A	N/A
Other ¹								
Carbon Dioxide	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Sulfur Dioxide 2	49	59	55	210	N/A	N/A	N/A	N/A
Nitrogen Oxide 2	235	180	180	206	N/A	N/A	N/A	N/A
Methane	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Nitrous Oxide 3	1	1	0	1	1	N/A	N/A	N/A
Total								
Carbon Dioxide	1,969,610	2,479,319	2,430,156	2,453,966	2,512,498	2,886,482	3,315,362	3,653,182
Sulfur Dioxide	15,909	11,396	10,850	10,293	N/A	9,290	8,950	8,950

Nitrogen Oxide	6,663	5,330	4,917	4,699	N/A	3,989	4,175	4,286
Mercury	N/A	N/A	N/A	50,081	49,699	54,076	55,452	55,966
Methane	12	14	14	14	14	N/A	N/A	N/A
Nitrous Oxide	26	33	33	33	34	N/A	N/A	N/A
Sulfur Hexafluoride ⁴	2	1	1	1	1	N/A	N/A	N/A

Sources: EIA, *Annual Energy Outlook 2005*, DOE/EIA-0383 (2005) (Washington, D.C., February 2005), Tables A8 and A18, EIA, *Emissions of Greenhouse Gases in the United States 2003*, DOE/EIA-0573(2003) (Washington, D.C., December 2004) Tables 10, 17, 25, 29, and EPA, *National Emission Inventory - Air Pollutant Emission Trends*, "Average Annual Emissions, All Criteria Pollutants," August 2003, <http://www.epa.gov/ttn/chief/trends/index.html>.

Notes:

Emissions from electric-power sector only.

¹ Emissions total less than 500 tons.

² Emissions from plants fired by other fuels; includes internal combustion generators.

³ Emissions from wood-burning plants.

⁴ Sulfur hexafluoride (SF₆) is a colorless, odorless, nontoxic, and nonflammable gas used as an insulator in electric T&D equipment. SF₆ has a 100-year global warming potential that is 22,200 times that of carbon dioxide and has an atmospheric lifetime of 3,200 years.

Table 11.2 – Installed Nameplate Capacity of Utility Steam-Electric Generators With Environmental Equipment

(Megawatts)

	<u>1990</u>	<u>2000</u>	<u>2001</u>	<u>2002</u>
Coal Fired				
Particulate Collectors	315,681	321,636	329,187	329,459
Cooling Towers	134,199	146,093	154,747	154,750
Scrubbers	69,057	89,675	97,804	98,363
Total ¹	317,522	328,741	329,187	329,459
Petroleum and Gas Fired				
Particulate Collectors	33,639	31,090	31,575	29,879
Cooling Towers	28,359	29,427	34,649	45,747
Scrubbers	65	0	184	310
Total ¹	59,372	57,697	61,634	71,709
Total				
Particulate Collectors	349,319	352,727	360,762	359,338
Cooling Towers	162,557	175,520	189,396	200,497
Scrubbers	69,122	89,675	97,988	98,673
Total ¹	376,894	386,438	390,821	401,168

Source: EIA, *Annual Energy Review 2003*, DOE/EIA-0384 (2003) (Washington, D.C., September 2004), Table 12.8.

Notes:

¹Components are not additive because some generators are included in more than one category.

Through 2000, data are for electric utilities with fossil-fueled steam-electric capacity of 100 megawatts or greater.

Beginning in 2001, data are for electric utilities and unregulated generating plants (independent power producers, commercial plants, and industrial plants) with fossil-fueled or combustible renewable steam-electric capacity of 100 megawatts or greater.

Table 11.3 – EPA-Forecasted Nitrogen Oxide, Sulfur Dioxide, and Mercury Emissions from Electric Generators

	EPA Base Case 2000				Clear Skies Case			
	<u>2005</u>	<u>2010</u>	<u>2015</u>	<u>2020</u>	<u>2005</u>	<u>2010</u>	<u>2015</u>	<u>2020</u>
SO ₂ (Thousand Tons)	10,267	9,861	9,227	8,961	8,424	6,242	5,475	4,403
NO _x (Thousand Tons)	3,896	3,951	4,017	4,066	3,647	2,186	2,162	1,796
CO ₂ (Thousand Tons)	2,428,503	2,632,377	2,795,022	2,960,312	2,412,371	2,599,277	2,758,912	2,899,061
Mercury (Tons)	52	53	52	52	49	35	34	30

Source: Environmental Protection Agency (EPA), Clear Skies Initiative Analysis, Runs Table for EPA Modeling Applications 2003 Using IPM <http://www.epa.gov/airmarkets/epa-ipm/results2003.html>, EPA Base Case for 2003 Analyses <http://www.epa.gov/airmarkets/epa-ipm/EPA216a9c.zip>, and 2003 Clear Skies Act Case <http://www.epa.gov/airmarkets/epa-ipm/EPA216c3.zip>

Notes:

The proposed Clear Skies legislation would create a mandatory program that would dramatically reduce power plant emissions of sulfur dioxide (SO₂), nitrogen oxides (NO_x), and mercury by setting a national cap on each pollutant. <http://www.epa.gov/air/clearskies/>

Clear Skies would:

Cut sulfur dioxide (SO₂) emissions by 73 percent, from year 2000 emissions of 11 million tons to a cap of 4.5 million tons in 2010 and to a cap of 3 million tons in 2018.

Cut emissions of nitrogen oxides (NO_x) by 67 percent, from year 2000 emissions of 5 million tons to a cap of 2.1 million tons in 2008 and to a cap of 1.7 million tons in 2018.

Cut mercury emissions by 69 percent - the first-ever national cap on mercury emissions. Emissions would be cut from 1999 emissions of 48 tons to a cap of 26 tons in 2010 and to a cap of 15 tons in 2018.

Analytical Framework of IPM • EPA uses the Integrated Planning Model (IPM) to analyze the projected impact of environmental policies on the electric power sector in the 48 contiguous states and the District of Columbia. Developed by ICF Resources Incorporated and used to support public and private sector clients, IPM is a multi-regional, dynamic, deterministic linear programming model of the U.S. electric power sector. • The model provides forecasts of least-cost capacity expansion, electricity dispatch, and emission control strategies for meeting energy demand and environmental, transmission, dispatch, and reliability constraints. IPM can be used to evaluate the cost and emissions impacts of proposed policies to limit emissions of sulfur dioxide (SO₂), nitrogen oxides (NO_x), carbon dioxide (CO₂), and mercury (Hg) from the electric power sector. • IPM was a key analytical tool in developing the President's Clear Skies proposal.

Table 11.4 – Market Price Indices for Emissions Trading in the South Coast Air-Quality Management District

	<u>1996</u>	<u>1997</u>	<u>1998</u>	<u>1999</u>	<u>2000</u>	<u>2001</u>	<u>2002</u>	<u>2003</u>	<u>2005</u>	<u>2010</u>
Market Price Indices ¹										
RECLAIM Trading Credit (\$/lb) ²										
Nitrogen Oxide	0.05	0.08	0.20	0.90	42.69	11.11	0.70	0.62	3.00	3.00
Sulfur Dioxide	0.15	0.08	0.34	0.29	1.14	6.82	4.00	2.25	3.04	2.84
Emission Reduction Credit (\$/lb/day) ³										
Nitrogen Oxide	2,070	2,908	4,515	4,560	7,675	16,809	8,000	8,458	NA	NA
Sulfur Dioxide	1,367	1,740	1,687	1,687	3,721	7,184	7,500	7000	NA	NA
Particulate Matter (<10 microns)	2,418	1,947	1,981	3,175	6,942	19,030	22,000	25000	NA	NA
Reactive Organic Gas	1,075	754	744	735	1,904	1,869	1,475	1100	NA	NA
Carbon Monoxide	NA	NA	NA	NA	1,000	7,259	7,000	7000	NA	NA

Source: Cantor Fitzgerald EBS, SCAQMD RTC/ERC MPI History, <http://www.emissionstrading.com>.

Notes:

¹ Market Price Indices (MPIs) reflect current market conditions for a particular date. Dates used here are end of year: 11/12/96, 12/29/97, 12/21/98, 12/27/99, 12/28/00, 12/7/01, 12/19/02 and 12/19/03. 2005 and 2010 prices as of 12/30/03 for all NOx products, 7/29/03 for 2005 SOx RTCs, and 07/02/03 for 2010 SOx RTCs. Prices are an average of the most recent price, lowest bid, and highest bid for RTC and ERC transactions executed by Cantor Fitzgerald and/or reported by the South Coast Air Quality Management District (SCAQMD) for 2,000 pounds or more of RTCs or 10 lbs/day or more of ERCs. SCAQMD was chosen because it is the region with the greatest number of emissions traded.

² In the RECLAIM program, the RECLAIM Trading Credit (RTC) is a limited authorization to emit a RECLAIM pollutant in accordance with the restrictions and requirements of the RECLAIM rules. Each RTC has a denomination of one pound of RECLAIM pollutant and a term of one year, and can be held as part of a facility's Allocation or alternatively may be evidenced by an RTC Certificate.

³ Emissions Reduction Credits (ERCs) are reductions in emissions that have been recognized by the relevant local or state government air agency as being real, permanent, surplus, and enforceable. ERCs are usually measured as a weight over time (e.g., pounds per day or tons per year). Such rate-based ERCs can be used to satisfy emission offset requirements of new major sources and new major modifications of existing major sources.

Table 11.5 – Origin of 2003 Allowable SO₂ Emissions Levels

Type of Allowance Allocation	Number of Allowances	Explanation of Allowance Allocation Type
Initial Allocation	9,191,897	Initial Allocation is the number of allowances granted to units based on the product of their historic utilization and emissions rates (performance standards) specified in the Clean Air Act and other provisions of the Act.
Allowance Auctions	250,000	Allowance Auctions provide allowances to the market that were set aside in a Special Allowance Reserve when the initial allowance allocation was made.
Opt-in Allowances	99,188	Opt-in Allowances are provided to units entering the program voluntarily. There were 11 opt-in units in 2003.
TOTAL 2003 ALLOCATION	9,541,085	
Banked Allowances	8,646,818	Banked Allowances are those held over from 1995 through 2002, which can be used for compliance in 2003 or any future year.
TOTAL 2002 ALLOWABLE	18,187,903	

Source: EPA, *Acid Rain Program 2003 Progress Report*, Document EPA-430-R-04-011, November 2004, Figure 3.